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ABSTRACT

This guide, the third in a series of three, provides the intermediate science student and teacher an opportunity to review selected science concepts and processes through activities which emphasize the applicability of scientific knowledge in the professional world. The three components in this guide deal with (1) the scientific principles of heating and cooling as related to careers in the environmental field; (2) the scientific knowledge necessary for professions in public service, in particular weather forecasting; and (3) the scientific skills necessary for transportation careers, with emphasis on satellite research and space travel. The activities in each of the components reinforce the student's skills in processes such as classifying, interpreting data, and controlling variables. Each activity contains an objective, key words, and a listing of materials needed to complete the learning experience. Simple experiments that students can perform have been included when applicable. In addition, the teacher is provided with a step-by-step outline of suggestions on how to implement the activity. An optional section in each component entitled "Home and Community" provides projects for extending the skills and knowledge gained to those areas. (NCR)

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APPLIED BASIC CURRICULUM SERIES

Science

a practical view

Teacher Edition

Volume III

ED227716

FL013 598

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INSTRUCTIONAL APPROACH

Science: A Practical View provides the intermediate science student and teacher an opportunity to review selected science concepts and processes through activities which emphasize the applicability of scientific knowledge in the professional world. The three activities in each of the three components reinforce the student's skills in processes such as classifying, interpreting data, and controlling variables. Each activity contains an objective, key words, and a listing of materials needed to complete the learning experience. Simple experiments that students can perform have been included when applicable. In addition, the teacher is provided with a step-by-step outline of suggestions on how to implement the activity. An optional section entitled Home and Community provides projects for extending the skills and knowledge gained to those areas. Since the components are independent and interchangeable, the teacher may select those which best meet the needs of the students. They may be presented as they are structured or reordered in another manner. The content also affords students with insight into his or her personal interests and abilities as they relate to preparation for the future. It is hoped that educators will find the materials helpful and motivational.

Component 1

Section One

Section Two

Section Three

HEATING, COOLING AND OUR ENVIRONMENT

OVERVIEW

This module relates scientific principles of heating and cooling to careers in the Environment Cluster, emphasizing how the study of science is necessary to these professionals. Students are given hands-on demonstrations and an opportunity to perform experiments related to temperature.

GOALS

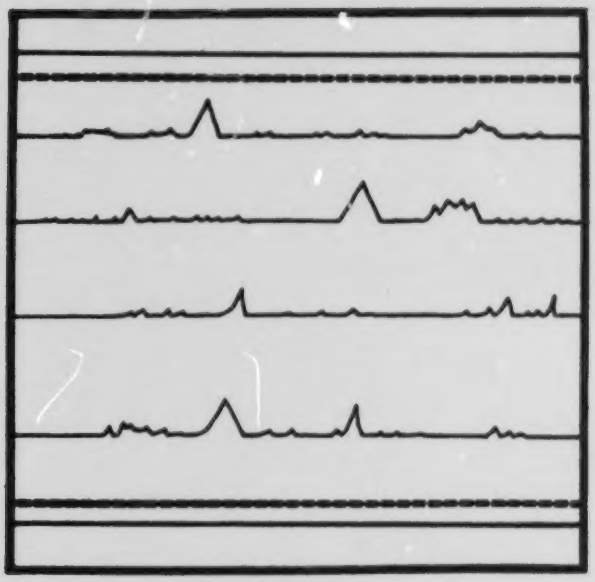
INTERPRETING DATA:	The student will relate scientific principles of heating and cooling to two careers in the Environment Cluster.
DEFINING OPERATIONALLY:	The student will complete a narrative and two experiments related to temperature and environment.
FORMULATING MODELS:	The student will investigate the careers that are related to plant life and carry out an experiment to investigate the effects of temperature.

LEARNING SECTIONS

SECTION 1: Pete Gonzalez, Geographer

SECTION 2: Talk Show

SECTION 3: Some Advice from Alex David



COMPONENT I

Section One

Section One
Pete Gonzáles, Geographer

Learning Objective

Given a narrative relating scientific principles of temperature to careers in the Environment Cluster, the student will answer the evaluation questions with 75% accuracy.

Key Words

- radiation
- geographer
- forest ranger
- atmosphere

Domains and Levels

Cognitive : Knowledge, Comprehension, Application

Affective : Receiving, Responding

Materials

- narrative
- tin cans
- light bulb
- orange
- knitting needle
- hot plate
- paper spiral
- stick

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher may begin the lesson by reviewing the relationship between high and low temperatures and weather. It may be pointed out that this information is important in many careers in the Environment Cluster.

STEP II - The narrative may be read by the teacher, who may elect to perform the first demonstration or have a group of students perform it. In either case, the temperature should be recorded at 5 minute intervals for at least 20 minutes.

STEP III - The second demonstration may also be set up and performed by the teacher, who may take the opportunity to guide the students to the proper conclusion, or students may be assigned the demonstration.

STEP IV - The worksheet questions may be answered and the answers shared and discussed.

STEP V - Evaluation

STEP VI - The Home and Community activity is optional, to be completed if time permits.

STUDENT ACTIVITY MATERIAL

INTRODUCTION

Our atmosphere is heated by the sun. The heat reaches the earth by radiation, which is the movement of energy in waves through space. The heat is absorbed by the earth and is radiated back from the earth. The best absorbers of heat are rough, dark surfaces. Try this experiment to compare the effect of sunlight on water:

EXPERIMENT

1. Use two tin cans.
2. Paint one black.
3. Fill each with equal amounts of water.
4. Put a thermometer in both and set them in the sunlight.
5. Record the temperature at 5-minute intervals.

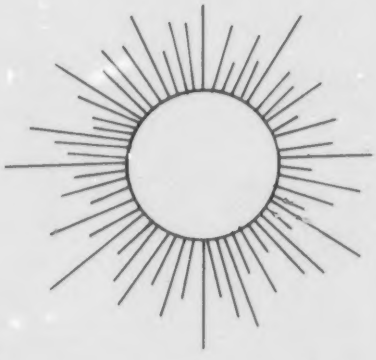
QUESTION

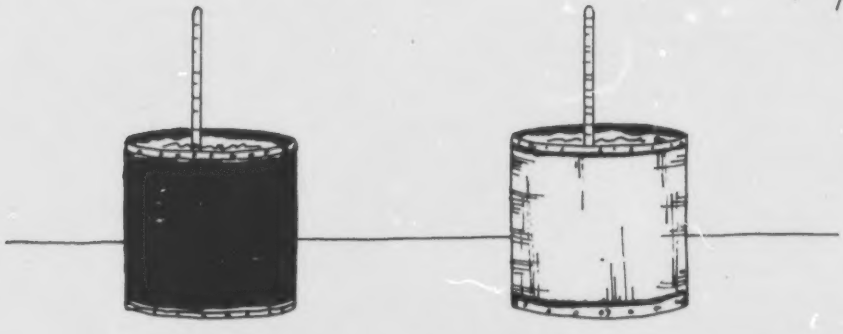
What conclusions can you draw from this?

_____

_____

_____





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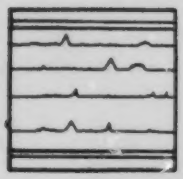
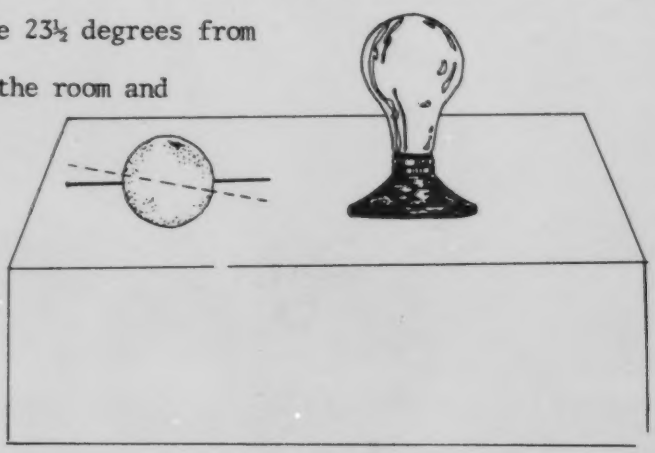


Pete González, Geographer

Some people who work at jobs in the Environment Cluster have put scientific knowledge to good use. The effect of high and low temperatures on the weather are very important to them. Pete González is a regional geographer. His job is to study the physical, social, political, and economic characteristics of one particular region. He has a degree in geography and is still studying because he is interested in doing research on how high or low temperatures can affect a region. Pete knows that temperature can decide where people live, how they earn their living, and even which hobbies or sports they will pursue. Right now, Pete is studying the effect of high and low temperatures on a small river basin in Texas. Here are some scientific facts that Pete learned in school that have been useful to him:

a. The weather is cooler in our part of the world than at the equator. Put a light bulb on a table to represent the sun. Put a knitting needle through the center of an orange to represent the axis of the earth. Tilt the needle 23½ degrees from the vertical. Darken the room and move the orange to a different position. What comment can you make about the light at the equator? What else do you observe?



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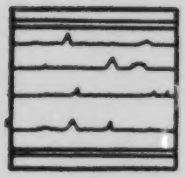


b. Warm air rises while cold air moves in and pushes it up. Cut a spiral of paper. Attach it to a stick and hold it over a hot plate. What do you observe?

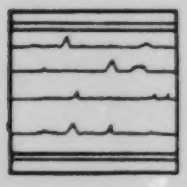
_____

_____

c. Surface features of the earth affect temperature. In the river basin, there are various hills, one 1000 feet tall. Pete finds a difference in temperature between the river basin and the high hill. Can you explain why? _____

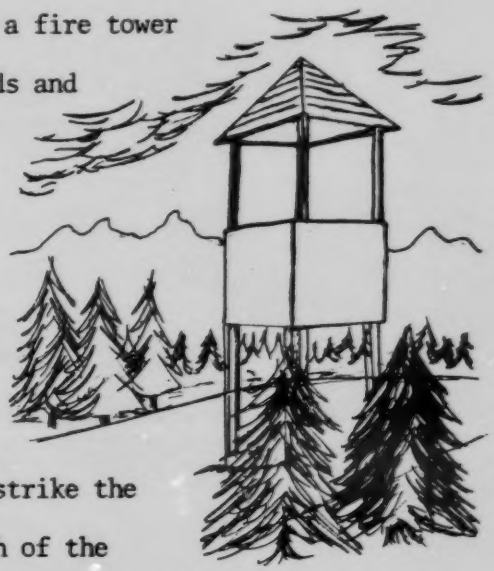
_____

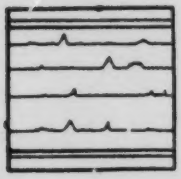
To be a geographer like Pete, you must have a thorough background in science. It helps if you have a curious, open mind. You should also like to work with ideas and theories. If you are patient and enjoy research, you may want to become a geographer like Pete.



Carmen Marie Rouseau

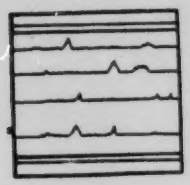
When I told my family about my future career plans, they were surprised, to say the least. We live near Montreal, Canada, and I have always been fascinated by the forests near my home. They have always seemed like a green treasure to me, and the forest rangers like the guardians of the treasure. I told my folks I wanted to be a forest ranger. Everyone seemed to be against the idea because I am a girl, so I had to plan carefully. One of the first things I did was to be sure I was taking all the science courses I could. I knew I could climb, ride, and ski as well as my brother and that my health was good. I thought I could do very well as a ranger in a fire tower or as a conservationist protecting forest lands and wildlife. But I had not shown I was very good at science. However, soon I began to see how basic science related to my career choice. Then I began to get better grades. I learned that high and low temperatures play a big part in the weather, and the weather has a lot to do with my career. The sunrays strike the earth less directly as you move north or south of the equator. The average temperature decreases the further





away you move. Temperature also varies with the seasons. In summer, there are more hours of daylight, so it's warmer. Also, the rays of the sun hit the earth more perpendicularly then. Temperature, along with other factors, also determines what kind of vegetation grows in an area. Different species of plants react differently to temperature conditions. Plants that are natives of far northerly latitudes are able to withstand low winter temperatures without injury, but cannot endure high summer temperatures.

Plants of tropical origin must have warmth throughout the year. In the coniferous forest, the summer is short and cool, while the winter is cold and long. Pine and evergreen forests have supplied the wood for man for thousands of years. The more I study, the more I find out about forests. This summer I plan to work with the rangers to see if I have made the correct career decision. There are many summer jobs available to high school and college students who might be interested in being a forest ranger. And this means girls as well as boys!



Worksheet

1. Name the two careers mentioned in the narrative. _____

   _____ and _____

2. The movement of energy in waves through space is called_____

3. Which tin can showed a higher rise in temperature in the first demonstration? _____

   Why? _____

   _____

4. Give an example of surface features of the earth that affect temperature _____

   _____

   _____

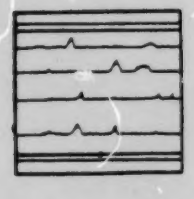
5. How does temperature affect plants in northern latitudes?

   _____

   _____

6. Give an example of how high or low temperature affects you. _____

   _____



Answer Key

1. Geographer and Forest Ranger
2. radiation
3. The tin can painted black. Because rough or dark surfaces absorb more heat.
4. The temperature is lower on a mountain top than in a river basin.
5. Plants in northern latitudes withstand low winter temperatures but cannot endure high summer temperatures.
6. Accept all logical answers.

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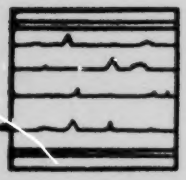
HOME and COMMUNITY

Students may, with the help of parents, make a drawing showing the kind of plants that grow on the north or south sides of their homes. The effect of high and low temperatures on the plants may be inferred, and a report prepared for the teacher.



EVALUATION

1. Why are scientific concepts, such as temperature and weather, important to a geographer? _____

_____

_____

_____

2. What kind of person makes a good geographer? _____

_____

_____

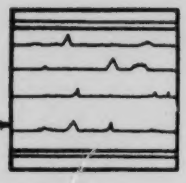
_____

3. What kind of surface absorbs heat better? _____

_____

4. In what way are temperatures related to vegetation in northern latitudes? _____

_____



EVALUATION

Answer Key

1. A geographer must have a thorough knowledge of scientific principles because he or she uses them in the profession. Concepts such as temperature, air movement, and other aspects of weather influence where people live, how they earn their living, and even which hobbies or sports they pursue.
2. A geographer, along with other kinds of scientists, should have a curious, open mind; like to work with ideas and theories; be patient and enjoy research.
3. A rough, dark surface absorbs heat better.
4. Plants in northern latitudes withstand low winter temperatures but cannot endure high summer temperatures.

COMPONENT I
Section Two

Section Two
Talk Show

Learning Objective

Given information about the environment, the student will answer questions with 80% accuracy on the evaluation.

Key Words

- geophysicist
- geophysical prospector
- minerals

Domains and Levels

Cognitive: Knowledge, Comprehension

Affective: Receiving, Responding

Materials

- narratives
- bottle with cap
- marbles
- skillet
- ice water

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - For an introduction, the teacher may ask how weather is related to the earth system. Students may mention that weather such as rain smoothes and beats out rocks; that heat makes the soil and rocks dry and brittle; that cold cracks them.

STEP II - The teacher may explain to them that a Geophysicist is a scientist who investigates the physical aspects of the earth, and that a geophysical prospector is a special kind of geophysicist who looks for petroleum.

STEP III - The narrative may be read aloud by the teacher or the students. The experiments may be assigned as homework or done in class.

STEP IV - Activity sheet

STEP V - Evaluation

STEP VI - The Home and Community section is optional, to be assigned if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Talk Show

"Good morning from WRPI in Alamo, Texas! This is our weekly talk show. This morning we are going to be interviewing Michael Torres, who is a geophysicist. Because of the energy problems our country has been facing, research that leads to the discovery of new energy sources has become more and more important. A geophysical prospector, along with other scientists, engineers, technicians, drillers and helpers, locates new sources of oil, minerals or radioactive materials. These scientists apply the principles and techniques of mathematics and science to the study of the earth. In high school, they study physics, chemistry and geology, and in college they major in science or engineering. Data processing is helpful, also. A geophysicist or geophysical prospector must have mathematical ability, an analytical mind, and be in good physical condition. Sometimes they must endure isolation and rough conditions.

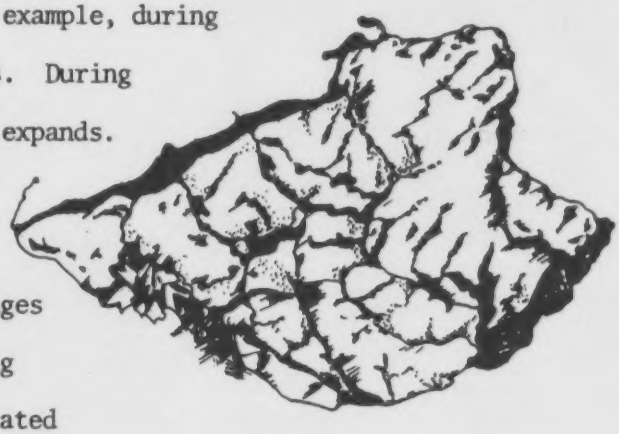
"Geophysics is a small field, so there are few openings each year. There are also few students prepared to fill them. The outlook for future jobs is good and expected to remain so. The field is growing because of the need for more oil and minerals, concern about the environment, and space exploration. Michael Torres is involved in exploration for more and better sources of energy. Good morning, Michael."

"Good morning. Thank you, Ms Lawrence, for the informative and flattering introduction. To begin our discussion I would like to talk about minerals and temperature.

EXFOLIATED GRANITE

"Minerals are very important in modern life. They are the deposits of rocks or ores that can be mined commercially. The earth contains hundreds of useful minerals, and scientists are constantly experimenting to find newer and better ways of using them. Minerals were formed in the earth millions of years ago by slow physical and chemical processes.

"Mineral deposits may occur naturally in the earth, or they may present a changed appearance caused by weathering or changes in the rock structures in which they are found. Temperature plays a big part in weathering. Freezing and thawing cause changes. For example, during warm periods, water gets into cracks. During cold periods, the water freezes and expands. The force may be great enough to split rocks. If you are curious about the effect of temperature changes on rocks, you might try the following experiments. You don't need complicated equipment to do scientific experiments. Everybody should be able to do these:



WEATHERING GRANITE

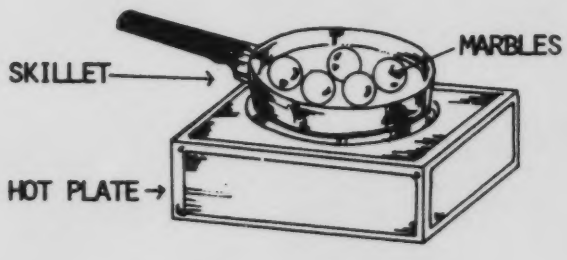
Experiment No 1

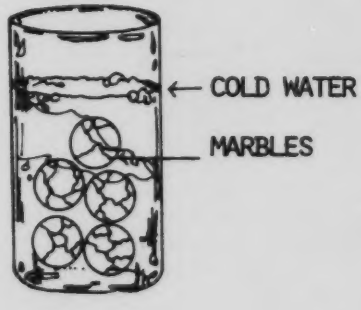
"Fill a bottle completely with water. Put a metal cap tightly on the

bottle. Place the bottle in a deep freeze at 0°. Report to the class the results.

Experiment No 2

"Heat some marbles in an old skillet until they are very hot. Then drop the marbles into a pan of ice water. Examine the marbles and report what happened.

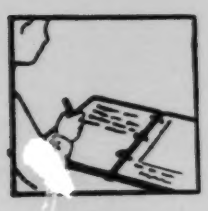




Other factors affect minerals, too. Tomorrow we will talk about the effect of erosion on rocks."

"Thank you, Mr. Torres, for your interesting talk. All of you people

out there can thank Mr. Torres and others like him for helping us understand some aspects of science better. We are looking forward to tomorrow's talk."



Activity Sheet

Complete the following:

1. The number of future jobs in geophysics is _____ .
2. _____ plays a big part in weathering.
3. A geophysicist must study _____ and _____.
4. Minerals were formed millions of years ago by _____ _____

Think it over:

Explain two ways in which temperature can affect minerals on rocks, one from the narrative and one from your ideas.

1. _____ _____
2. _____ _____

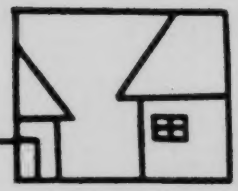
Answer Key

Complete the following:

1. growing
2. temperature
3. science and math
4. slow chemical and physical processes

Think it over

1. During warm periods water gets into cracks. It freezes during cold periods and expands, which may split rocks.
2. Accept all logical answers



HOME and COMMUNITY

The student may take samples of clay from different locations in the community and bake them in a pottery kiln. They may note the physical changes in each type of clay and then report to the class. Also, students may investigate what kinds of building stone are used for public and private buildings and theorize about the effect of changes in temperature on the stone.

EVALUATION

1. Why is there a growing need for geophysicists now? _____

_____

_____

_____

2. Explain how freezing and thawing cause changes in rocks.

_____

_____

_____

3. What education is needed to become a geophysicist? _____

_____

_____

4. What other qualities should a geophysicist have? _____

_____

_____

5. The processes which formed minerals are _____

and _____.

EVALUATION

Answer Key

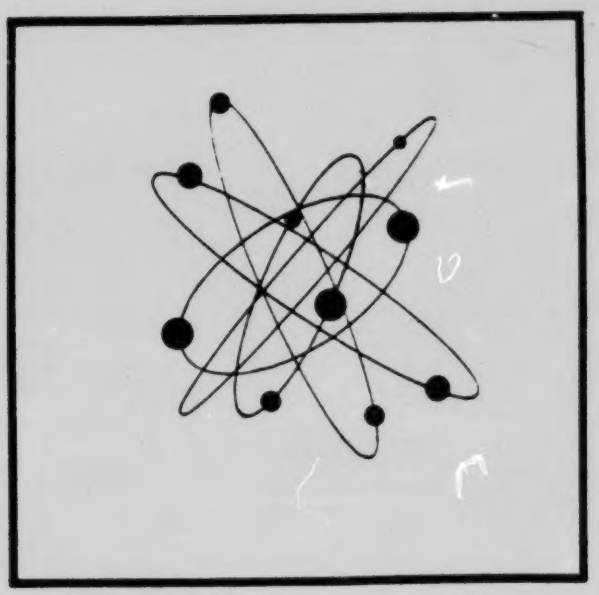
1. Because new sources of energy and new ways to use it are needed.

2. During warm periods, water gets in cracks, then freezes during cold periods. The force may be enough to cause rocks to split.

3. Science courses in high school; a degree with a major in science or engineering.

4. Analytical and math ability; good health; able to endure isolation and rough conditions.

5. physical and chemical



COMPONENT I
Section Three

Section Three
Some advice from Alex David

Learning Objective

Given information about a career in the Environment Cluster, the student will relate scientific data to plant growth with 70% accuracy on the evaluation.

Key Words

- soil conservationist
- soil scientist
- silviculturist
- wildlife biologist

Domains and Levels

Cognitive: Knowledge, Comprehension, Application

Affective: Receiving, Responding

Materials

- narrative
- flower pots
- soil
- coleus plants

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

The teacher may wish to follow these steps in presenting the activity:

STEP I - A general discussion of the importance of conservation may be initiated; then the teacher may guide the class to a discussion of careers that are related to the Environment Cluster.

STEP II - The relationship of temperature to growth of plants may be reviewed.

STEP III - The narrative may be read silently or aloud, depending on the reading level of the group. The teacher may use guided questions to clarify the jobs mentioned.

STEP IV - The worksheet may be answered orally.

STEP V - The experiment may be assigned as a project to be done at home, or the teacher may wish to do it in class.

STEP VI - Evaluation

STEP VII - The Home and Community activity is optional, to be assigned if there is sufficient time.

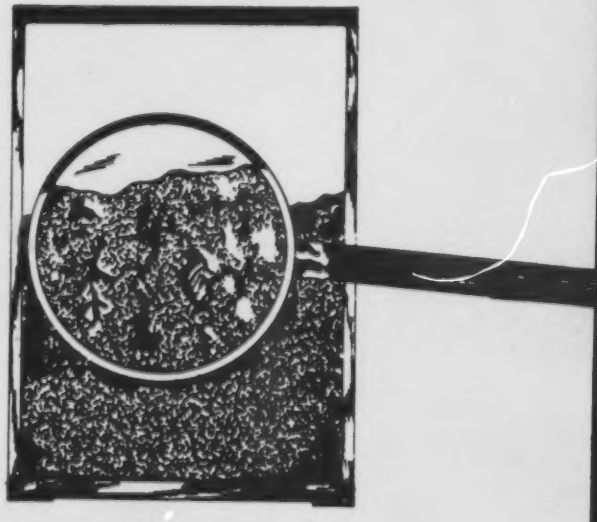
STUDENT ACTIVITY MATERIAL

Introduction

Will we always have enough soil to grow our crops on? Is our wild life in danger? Are we using up our forests? Conservation of natural resources is very important. Sometimes we take our resources for granted and think they will never run out. There are specialists in the Environment Cluster who are dedicated to protecting our natural resources. A silviculturist, for example, plants and cares for forest stands. A wildlife biologist uses principles, methods, techniques, and procedures of biology to conserve wildlife. A soil conservationist plans and develops ways to control soil erosion, and a soil scientist studies soils to identify and classify them with an eye to good use of available soil. These people may work for a government agency or private businesses, but the objective is the same: better use and conservation of our natural resources. Let's meet one of these professionals and see how science is used in his career.

Soil Conservation, A Way of Life

Alex David Jones is a soil conservationist for the Federal government. The agency he works for is called the Soil Conservation Service. His job is to help farmers set up good conservation practices on their farms. Soil is a mixture of rocks, leaves, roots, stems, and even animals that find their way into the soil. If you could examine a handful of soil from different spots, such as a shady lawn, a river bed, or a dusty road, you would see how different your samples were. Today, Alex David is taking samples from the old Harvest Hill ranch. The new owner of the ranch, Alicia Hendricks, is worried about the topsoil, a soft, spongy mixture of organic and inorganic material. Alex David walks from one location to another, picking up handfuls of soil, crumbling them in his hands. Part of the field he is examining has very little topsoil. He will prepare a soil profile, perform chemical tests to determine the acidity of the soil, and find out about the nitrogen content.

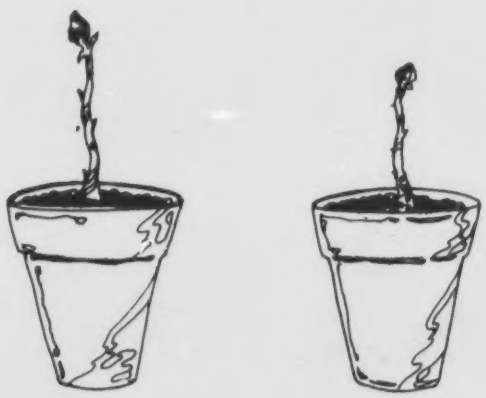


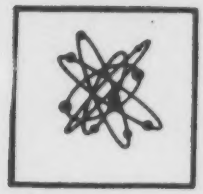
Alex David knows that temperature has a lot to do with soil conditions. Since the field he is examining slopes down toward the north, he knows the temperature there will be lower than on a south-facing slope, even on a sunny day. Air and other gases have a lot to with good top soil, too. Air fills the space

between soil particles and helps keep it loose and ready for plowing.

After looking over the soil, Alex David tells Alicia that she must plant alfalfa, and when it grows, plow it under. This is called crop rotation, the method of planting first one kind of crop, then another. Crop rotation keeps the soil rich. He also suggests she add loam, a mixture of sand, clay, silt, and humus to the soil. Alicia is new at farming, so she thanks David, and says she will let him know if she has any more problems.

Try this experiment to find out how temperature affects plant life. You will need two coleus the same size, two flower pots, and soil. Plant them, and place one in the warmest room in your house. Place the other in the coolest room in your house. Water them at the same times with equal amounts of water. Be sure they get the same amount of light. After a month, measure the plants. What is your conclusion?





Worksheet

I. Match the following by drawing a line from the term on the left to the correct definition on the right.

silviculturist .	. identifies and classifies soil
wildlife biologist .	. uses principles, methods, techniques of biology
soil scientist .	. controls soil erosion
soil conservationist .	. plants and cares for forest stands

II. Soil is a mixture of _____

_____

_____

III. Crop rotation is _____

_____

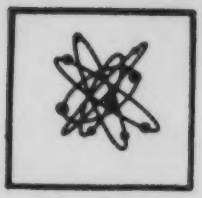
_____

IV. The direction a slope faces affects the _____

_____

V. Loam is _____

_____



Worksheet Answers

I. Match the following by drawing a line from the term on the left to the correct definition on the right.

silviculturist	identifies and classifies soil
wildlife biologist	uses principles, methods, techniques of biology
soil scientist	controls soil erosion
soil conservationist	plants and cares for forest stands

II. Soil is a mixture of rocks, leaves, roots, stems, and even animals.

III. Crop rotation is planting a crop, plowing it under, then planting another crop after a time.

IV. The direction a slope faces affects the temperature.

V. Loam is a mixture of sand, clay, silt, and humus.

HOME and COMMUNITY

The student may examine the growth of grass in shady and sunny parts of the playground. On a warm day, temperature readings may be taken at depths of 6 inches, 12 inches, and 18 inches. A report may be made to the class about the results.

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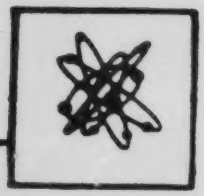
EVALUATION

You are a soil conservationist. Right now you are looking over a farm in the hill country. Explain some of the things you will look for.

EVALUATION



Evaluation Key

You are a soil conservationist. Right now you are looking over a farm in the hill country. Explain some of the things you will look for.

Accept all logical answers. Students may mention amount of topsoil, kind of topsoil, chemical composition of soil, nitrogen content, location and temperature.

Component 2

Section One

Section Two

Section Three

HOW'S THE WEATHER?

OVERVIEW

All of the activities presented in this component allow the student to learn about various professions in Public Service. At the same time, students will appreciate the scientific knowledge necessary to do these jobs well. Section One presents the student with a specific career and the use of weather data in that job. Section Two uses a dramatic event, a forest fire, to point out the importance of weather predicting. In Section Three the student will examine the effect of weather on insect population, predicting the outcome of a stated situation.

GOALS

OBSERVING:	The student will be able to relate scientific methods to work activities of a selected career in the Public Service Cluster.
INFERRING:	The student will examine the importance of weather predicting in various jobs in Public Service.
PREDICTING:	The student will predict the outcome of a given situation related to weather and insect population.

LEARNING SECTIONS

SECTION 1: *Weather Forecasting*

SECTION 2: *The Forest Fire*

SECTION 3: *The Grasshopper Plague*

COMPONENT II

Section One

Section One
Weather Forecasting

Key Words

- Celsius
- Fahrenheit
- predicting
- meteorologist
- counselor
- isobars

Learning Objective

Given a narrative concerning a job related to weather prediction, the student will observe and analyze weather data with 60% accuracy on the evaluation.

Materials

- sufficient copies of the activity and evaluation sheets for all students.

Domains and Levels

Cognitive : Knowledge, Comprehension, Analysis

Affective : Receiving, Responding

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should introduce the activity by reviewing some of the basic concepts or knowledge about weather and lead a brief discussion about why predicting the weather is important.

STEP II - The students should read the narratives to themselves or take turns reading them aloud.

STEP III - The teacher should lead a discussion based on the questions interspersed in the narrative. Some other questions used in the discussion might be:

1. Why is it useful to talk to a school counselor about future career plans?
2. What qualities should a good meteorologist have?
3. Why do some subjects get more interesting as you study them?

STEP IV - The students should complete the worksheet. Answers may be shared with the class.

STEP V - Evaluation.

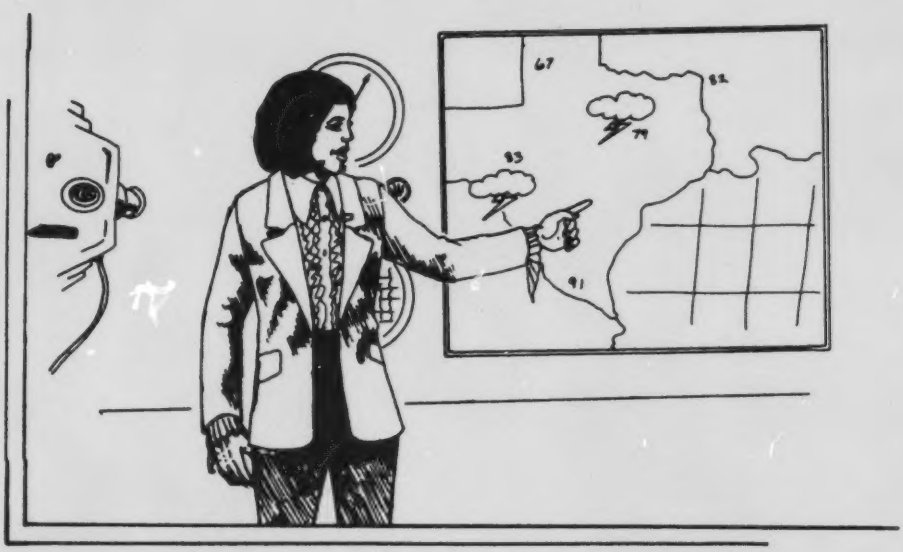
STEP VI - The Home and Community section is optional and should be done if time permits.

STUDENT ACTIVITY MATERIAL

Weather Forecasting

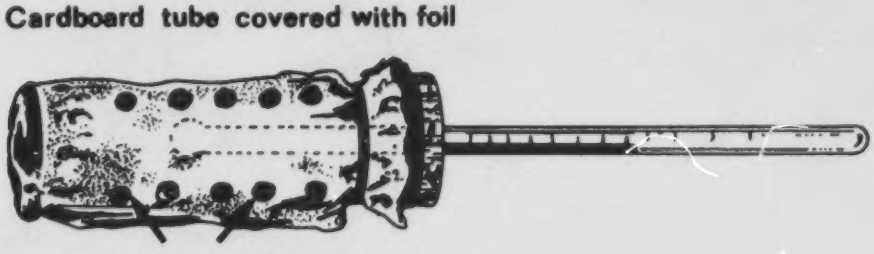
"If you don't like the weather in Texas, just wait a few minutes!" Sandra Gloria smiled as she heard this comment. She had heard people say this often since she moved to Texas. The saying referred to the fact that sudden changes in the weather are common in Texas. Sandra was interested in meteorology, the science of weather and weather forecasting. She had found out in science class that meteorologists help solve many practical problems in agriculture, transportation, health, and business. Today she has an appointment with the school counselor to discuss the possibility of becoming a meteorologist.

School counselors, as well as teachers, are part of a large group of people who work in jobs called Public Service. Their task is to advise students about choosing a career, but they also help make school



a meaningful experience for all students. Mr. Heinman has a lot of information for Sandra. He plans to tell her about the courses she should be taking, the colleges she could attend, and possible financial aid. He has a kind, sympathetic attitude toward the students he counsels. Sandra found out from her talk with Mr. Heinman that there are different kinds of meteorologists. Some forecast the weather; some do basic and applied research while some, called climatologists, study long range climate trends. The counselor had many books about different jobs. Together, Sandra and Mr. Heinman found that the job of meteorologist or weather forecaster was the job that had most to do with predicting the weather, but that there were other jobs in which knowing the weather was important too, such as that of forest ranger or a vocational agriculture teacher. A forest ranger needs to know how to predict the weather because he or she must be outside in the woods much of the time. Weather also has a lot to do with whether and where forest fires might start or how easy it will be to put them out. A vocational agriculture teacher must know a lot about weather because farmers must know how to predict the weather, since the success of their crops depends on the kind of weather. It is important to keep crops from being damaged by the weather or to make sure the crops benefit from the weather. A farmer who cannot predict the weather will soon go broke, and the job of the vocational agriculture teacher is to make sure his or her students know how to predict weather as well as possible.

The rest of the year after her chat with the counselor, Sandra paid extra attention in her science class. She found out that an ordinary thermometer measures only its own temperature. To measure the temperature of the air, something meteorologists must do, a special thermometer with a shield must be used to get the right reading in sunlight. Why do thermometers need a shield?



Sandra also learned about isobars, which are lines of equal pressure. They are shown as a heavy line on a weather map. (Iso means equal; Bar means pressure.) If a barometer were carried along an isobar or a line of equal pressure, the pressure would be the same everywhere, if kept at the same level above the sea. The map in the following page shows isobars in a weather map. Is the pressure the same in Galveston and Dallas?

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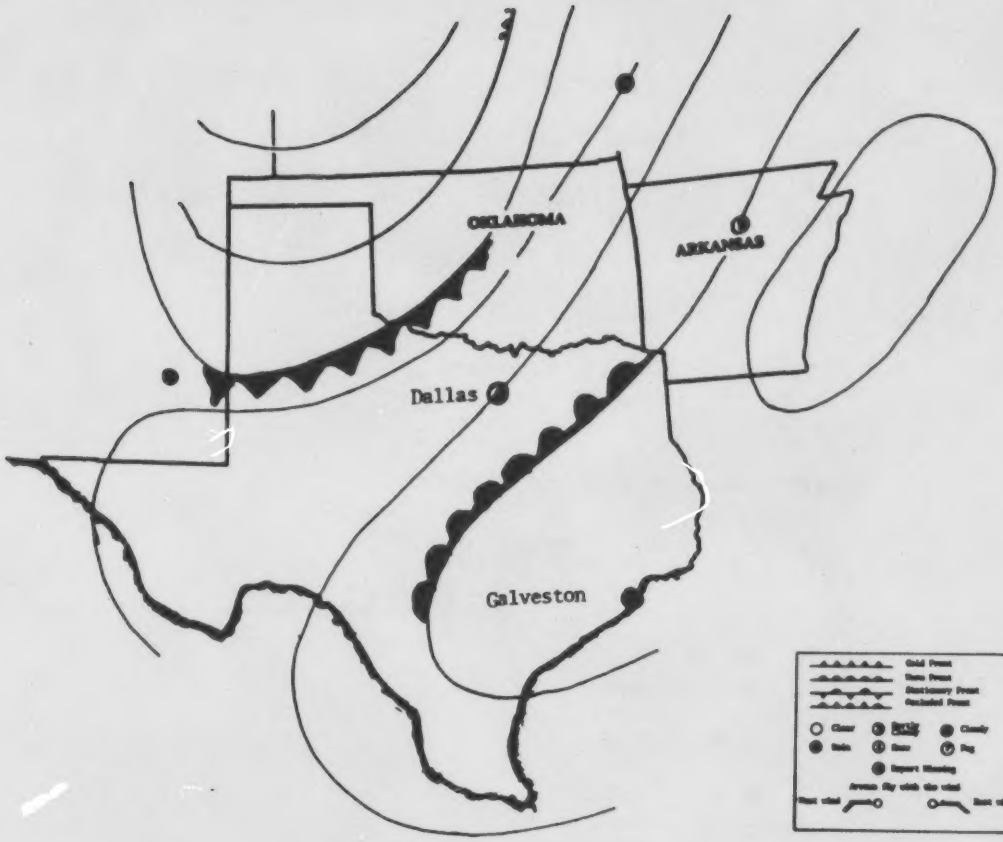

Since wind is important to the meteorologist, Sandra volunteered to make a weather vane for the class. The weather vane would be part of a weather station the class was setting up. Sandra looked at the illustration and read the instructions. (See picture in the following page.) Where do you think the weather vane should be located?

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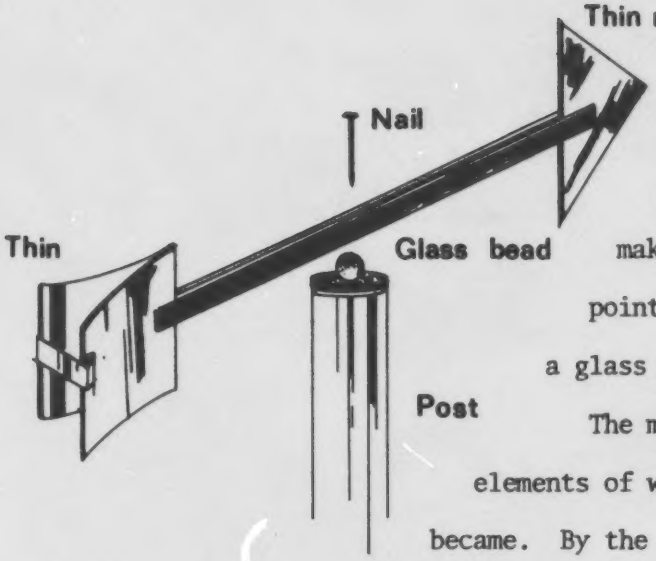
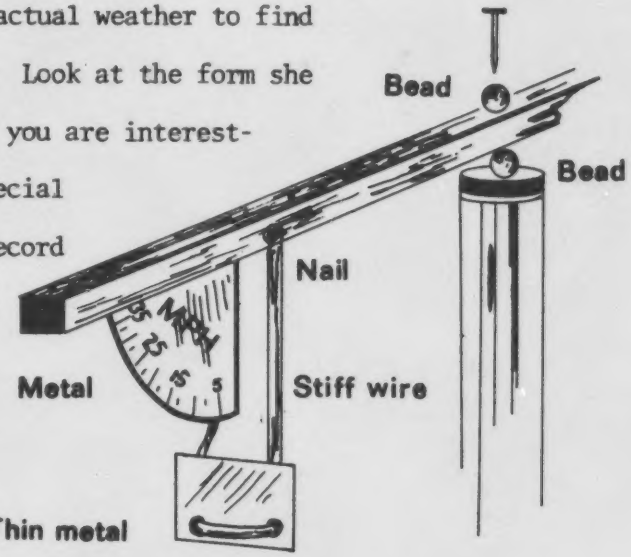


Slip pieces of thin metal into slots cut in a round stick. Balance the stick on the edge of a knife and then make a hole through the balance point. Pivot the vane on a nail with a glass bead for a bearing.

The more Sandra studied about the elements of weather, the more interested she became. By the end of the year, she was convinced the career of meteorologist was perfect for her. As part of her class project, Sandra kept a record of weather forecasts given in newspapers. Then she compared them with the actual weather to find out how many were accurate. Look at the form she used. Perhaps, like Sandra, you are interested in meteorology. As a special project you might like to record the weather data for a week and compare it with the actual weather.



		The newspaper says	The actual weather is
Monday	High temperature	_____	_____
	Low temperature	_____	_____
	Clear or Cloudy	_____	_____
	Wind	_____	_____
Tuesday	High temperature	_____	_____
	Low temperature	_____	_____
	Clear or Cloudy	_____	_____
	Wind	_____	_____
Wednesday	High temperature	_____	_____
	Low temperature	_____	_____
	Clear or Cloudy	_____	_____
	Wind	_____	_____
Thursday	High temperature	_____	_____
	Low temperature	_____	_____
	Clear or Cloudy	_____	_____
	Wind	_____	_____
Friday	High temperature	_____	_____
	Low temperature	_____	_____
	Clear or Cloudy	_____	_____
	Wind	_____	_____

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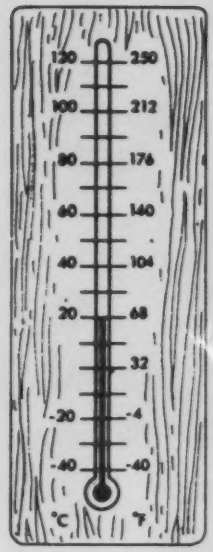
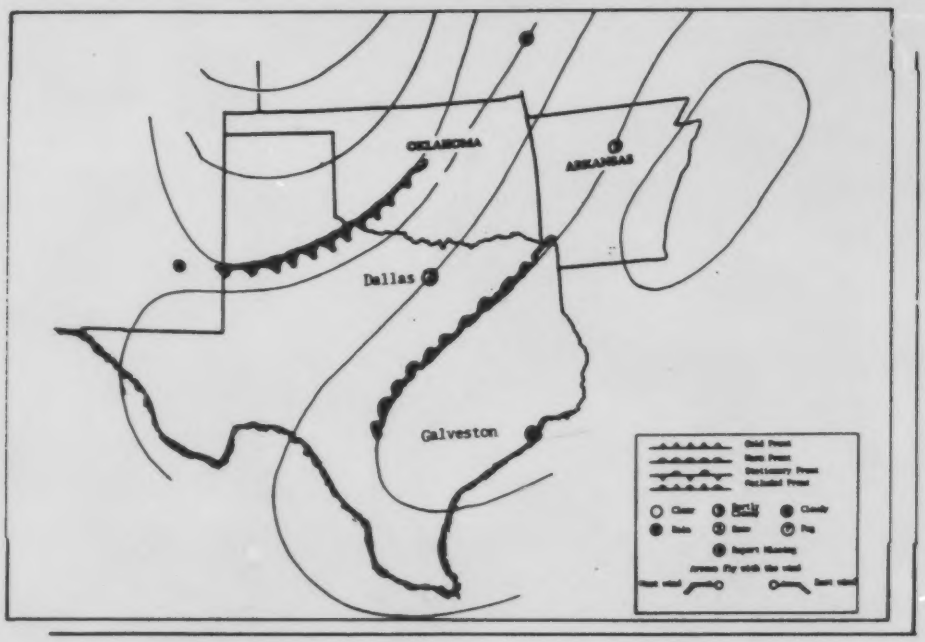
WORKSHEET

1. Temperature is very important in predicting the weather. Observe the thermometer on the right. It shows both Fahrenheit and Celcius temperatures. A reading of -4°F is equal to what Celcius temperature?



2. Observe the weather map below. What are the heavy lines called? _____ What do they indicate? _____



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3. Look at the weather data below. What is it describing?

NW 10 - 15 mph

_____

4. What other people besides meteorologists need to study weather data?

_____

_____

_____

5. Name three Public Service jobs.

_____

_____

_____

WORKSHEET ANSWERS

1. -4°F is equal to -20° Celsius

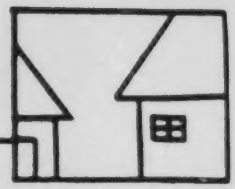
2. Isobars

   Areas of equal pressure

3. It describes the wind direction and velocity.

4. Farmers
   Oceanographers
   Forest rangers
   Vocational Agriculture teachers
   Accept all logical answers

5. School Counselor
   Meteorologist
   Vocational Agriculture teacher
   Climatologist
   Accept all logical answers.



HOME and COMMUNITY

The student, with the cooperation of other family members, may monitor the weather forecasting part of the nightly news on television. Data about the next day's weather may be written down; then a comparison may be made with the actual weather.

The student may have older family members who may be able to give an eye-witness account of severe weather, such as tornados, hurricanes, or ice storms. The student may interview the family member and take notes, which may then be used to report the event to the class.

EVALUATION

Complete the following:

1. The name of the science that studies weather and weather forecasting is _____.

2. An instrument that indicates the direction of the wind is a _____ _____.

3. Two careers that require knowledge about weather are:

   _____

   _____.

4. A school counselor's job is to _____

   _____.

5. Heavy lines or isobars on a weather map indicate areas that _____ _____.

6. Name three careers in Public Service.

   _____.

   _____.

   _____.

EVALUATION

ANSWER KEY

1. Meteorology

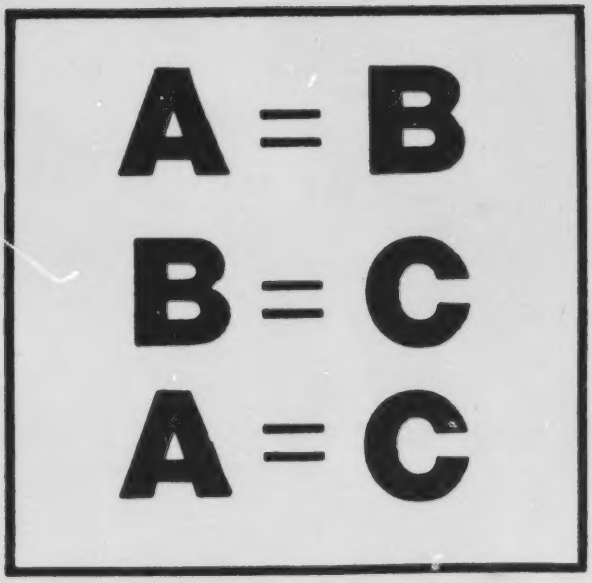
2. Weather vane

3. Farmers
   Forest rangers
   Accept all logical answers

4. A school counselor advises students about their future careers as well as other areas of interest and need.

5. Isobars indicate areas of equal pressure.

6. Meteorologist
   School Counselor
   Vocational Agriculture teacher
   Accept all logical answers



COMPONENT II

Section Two

Section Two

The Forest Fire

Key Words

- fringe benefits
- advancement opportunities
- cold front
- warm front
- hygrometer

Learning Objective

Given a narrative about the importance of weather prediction to various jobs in the Public Service Cluster, the student will write a paragraph describing his or her own preferences in job characteristics, according to the criteria of the teacher.

Materials

- copies of the narrative
- copies of the worksheet
- evaluation

Domains and Levels

Cognitive: Knowledge, Comprehension, Analysis, Synthesis

Affective: Receiving, Responding, Valuing

IMPLEMENTATION GUIDELINES

Time: *45 minutes*

STEP I - The teacher should introduce the activity by reviewing the vocabulary words and explaining the related weather concepts.

STEP II - The students should read the narrative silently. If there is a vocabulary item that is not clear, they may ask the teacher to explain.

STEP III - After the reading is completed, the teacher may briefly touch on the events of the narrative as well as the weather data. Students may be directed to the information sheet for discussion of cold and warm fronts.

STEP IV - Worksheet I may be answered as a group or individually.

STEP V - The teacher should then lead a discussion concerning job characteristics listed on the second worksheet. It would be helpful here to go over some concrete examples of these characteristics in different jobs and how several might be combined into one job. Job characteristics not on the list, such as "emotional appeal," "likes excitement and discovery," can also be discussed.

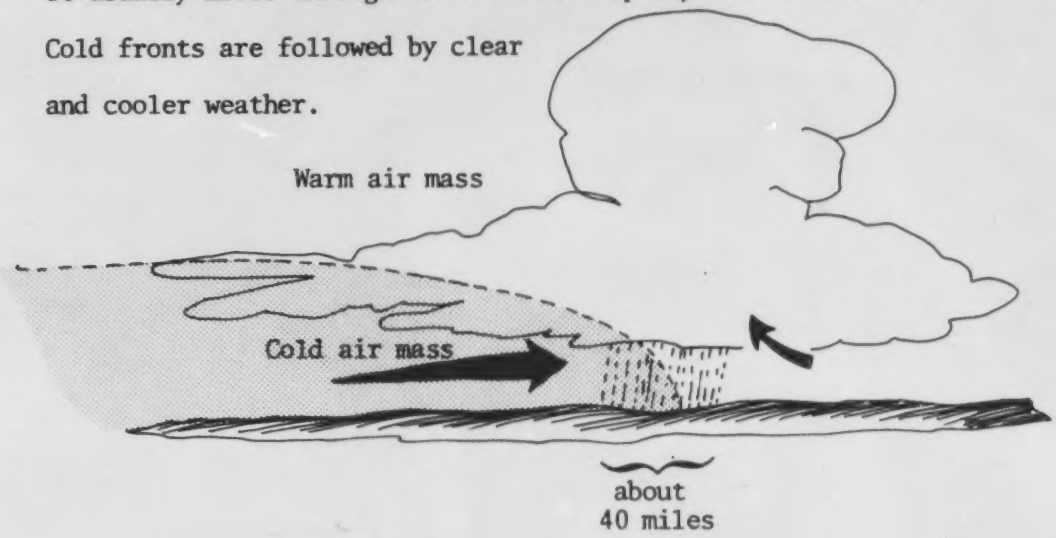
STEP VI - On the evaluation, students should be encouraged to write a paragraph about their own priorities in terms of job characteristics as given in the directions at the end of the evaluation sheet.

STEP VII - The Home and Community section is optional and can be completed if time allows.

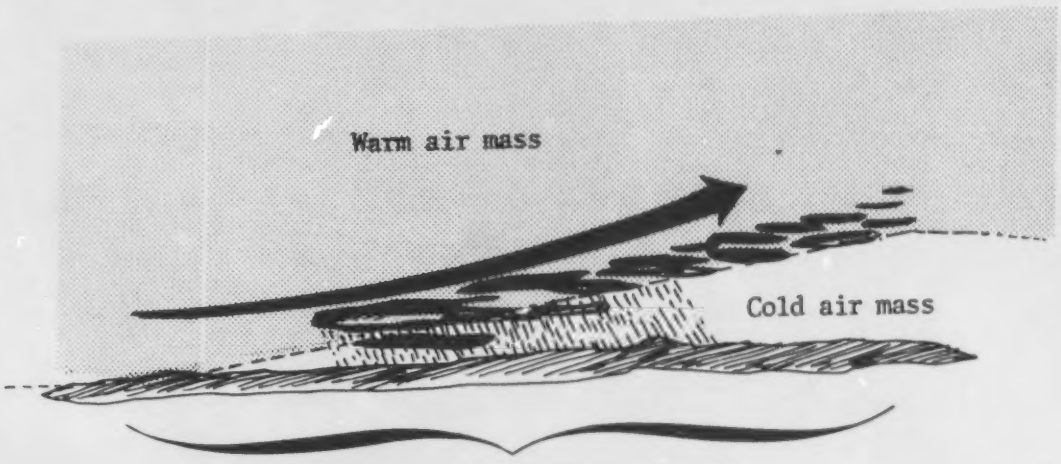
STUDENT ACTIVITY MATERIAL

Information Sheet

COLD FRONT: Is formed when a mass of cold air overtakes a mass of warm air. It usually moves through an area more rapidly than a warm front. Cold fronts are followed by clear and cooler weather.



WARM FRONT: Occurs when a mass of warm air pushes into a cold air mass. Its first indication is the appearance of high, thin clouds, which later become lower and darker. It is followed by rain or snow.



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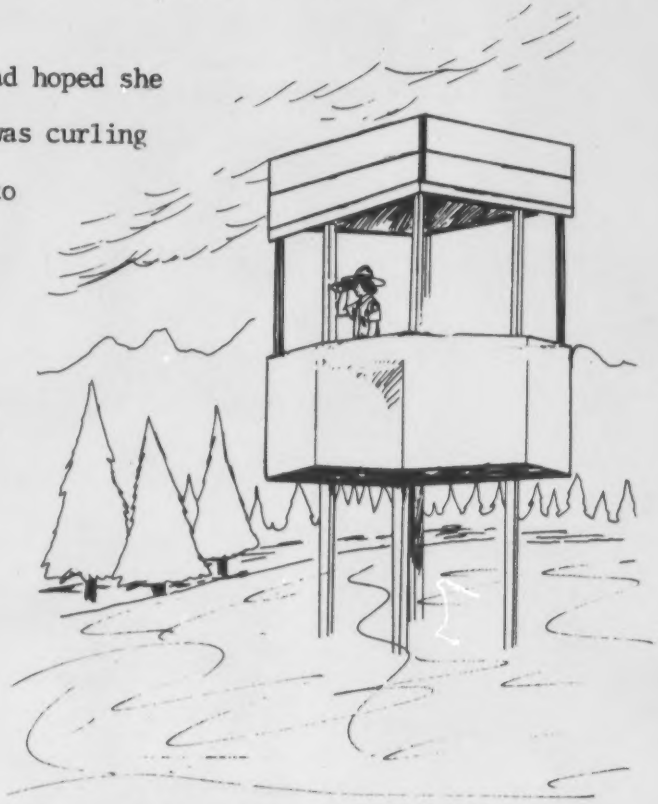
A = B
B = C
A = C

THE FOREST FIRE

It had been a hot, dry summer; but now, toward the end of September, it had gotten quite cool. Donna Brown was worried on this beautiful September morning as she sat at her post in the fire tower. She had become a forester because she loved the outdoors and liked teaching and talking about the forest. In the summer, college students often acted as fire spotters. Now the students were back in school, and Donna was in the tower. But today was different. The dry forest was just right for a fire, and Donna had to be alert, even though it was 6:30 a.m.



All at once Donna saw what she had hoped she wouldn't see. A thin wisp of smoke was curling up from the trees on a far hillside to the north. Donna grabbed the phone and called the forest fire highway department. She was glad that she had someone to work with in a crisis. She knew she could count on them no matter how bad things got. As she put down the phone and looked again at the smoke, she knew this fire would be a bad one. That thin wisp had now turned into a large mass covering much of the sky. "That's what happens when there's no rain for

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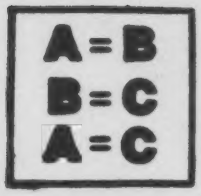
months," thought Donna. "I wonder if any rain is on the way." She called the weather service and found that there was a front just to the west, but it wasn't moving. "Here's hoping," thought Donna as she started mapping the exact movements of the fire.

Warm air and cold air do not mix easily because of the difference in density of the air masses. A moving warm mass tends to ride up over cooler air ahead of it. The invisible boundary, which is in front of the warm mass, is called a warm front. On the other hand, a moving cold mass of air pushes under the warmer air and is called a cold front. It is important to the weather forecaster to know the location of the mass of air, its front, and the speed and direction of the mass.

Lincoln Freeman was not surprised by the fire bell. His experience as a forest firefighter had taught him when fires were likely to come. The woods had been ready for a fire for weeks. Lincoln was excited. He hated to see the forest burn, but he loved the danger and fast-paced action of fighting the fire. Although the pay and the fringe benefits were small compared to the risks he took, Lincoln had no wish to do anything else. He grabbed his gear and ran to the waiting truck with the other firemen.

Back in the tower, Donna was busy giving the exact spot of the fire to the firemen. Then she began checking her records to see if there were any visitors in the park who were near the fire. Most of the visitors had gone with the summer, but Donna saw one entry which worried her. Manuel Rodríguez, a hunting and fishing guide, had a party of 4 fishermen right in the area of the fire. Donna knew they were in

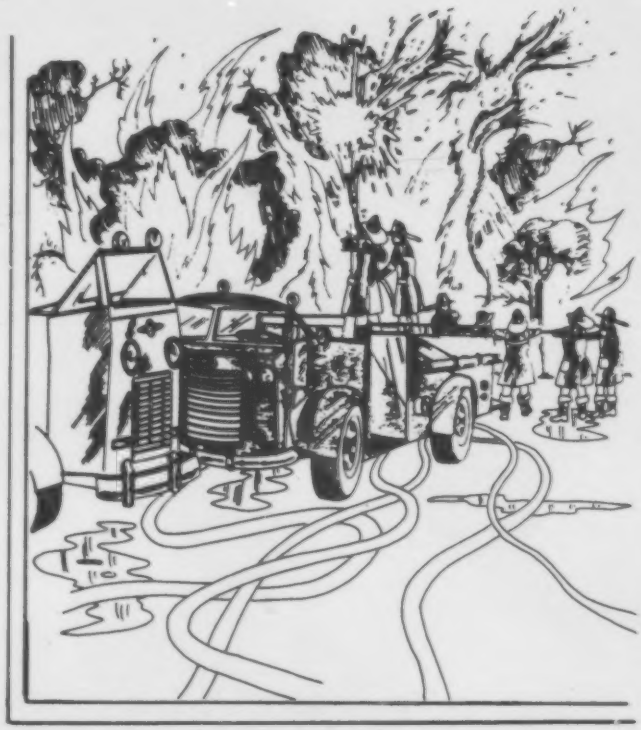


much danger, but she couldn't do anything about it. Even if she knew where they were, no truck or helicopter could get through the woods to reach them in time. Donna knew Manuel was wise in the ways of the woods. "If anyone can get himself out alive, it's Manuel," thought Donna.

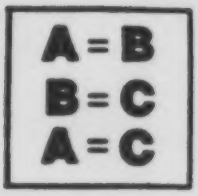
In the meantime, Manuel and his fishermen already knew about the fire. Manuel had smelled the smoke. He then climbed a tree on a high hill to see if he could see it. Yes! There it was, a little to the south. Manuel looked to the west. Not far away he could clearly see a huge bank of gray clouds that were slowly moving nearer and nearer.

The change in weather was important to everyone fighting the fire, but it was especially important to Manuel, since it could save his life. If it came slowly, the fire would reach the campers before they could get out of its way. But if it came quickly, the sudden meeting of hot and cold air would cause the warm air to expand and rise over the cold mass. The expanding warm air cools and causes clouds, and then rain. From what Manuel had seen, there were already plenty of clouds and the front seemed to be moving pretty fast. But more important for Manuel

and his fishermen, the meeting of hot and cold air would cause the wind to change and blow from the west or northwest. The combination of the rain and wind would slow down the rate of burning and change the direction of the fire, giving them time to get out of the forest. Soon the first drops of rain began to fall.



By the time the weather service had proven Manuel right in his prediction, Donna and the firefighters were busy making plans on how best to use the rain and wind change to their advantage. The fact that rain had come so soon after the beginning of the fire and that the wind direction had reversed were good signs. The fire might just burn itself out with hardly any help from them. Nevertheless, the fire crews were working hard on the eastern and western edges of the fire, making sure the fire would have nothing to burn after the wind change. At the end of the day the fire was out. Manuel, the fishermen and the firefighters, tired but happy, celebrated the success of their efforts.



WORKSHEET I

1. Name two jobs mentioned in the narrative in which predicting weather is important:

_____

_____

2. When a warm mass of air is moving, what will happen if it meets a cold mass?

_____

_____

3. What is a "warm front?"

_____

_____

4. Why don't warm and cool air mix easily?

_____

_____

5. Why did Donna enjoy her job?

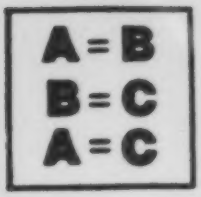
_____

_____

6. Why did Lincoln enjoy his job?

_____

_____



ANSWER KEY

WORKSHEET I

1. Forester
   Firefighter

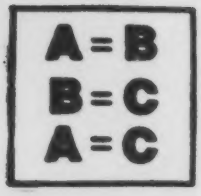
2. The warm air will ride up over the cooler air ahead of it.

3. The invisible boundary in front of the warm mass of air.

4. Because of the differences in their density.

5. She loved the outdoors and enjoyed teaching about the forest. She liked the people she worked with.

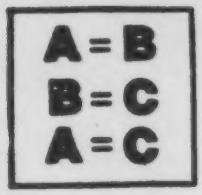
6. He loved danger and action.



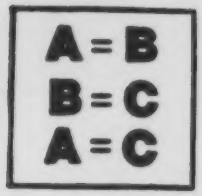
WORKSHEET II

The story you just read mentioned some reasons why a person might choose a job. Some of these reasons are:

1. Where the work takes place; for example, in the forest, the laboratory, the office, the classroom.
2. How much pay is offered for doing the work?
3. What kind of people are work companions?
4. What kind of extra benefits go with the job; for example, how many days are holidays, paid or unpaid vacation, insurance, overtime, and so on.
5. What kind of advancement opportunities there are; that is, are there jobs to which a person could be promoted if the work was good, so that after a few years one would have a much more important job.
6. The location of the job; for example, is the job in New York City or in Dallas? Is it in a small town, a big city, or in the country? Is it near mountains or the sea? This is important because of what a person likes to do with spare time. Some like to go to movies, walk in the woods, go surfing, climb mountains, go skiing, sunbathe on the beach, and so on.
7. Work schedule; for example, fixed hours from 9-5; mixed hours depending on when one is needed, like the firefighter; or open hours like the hunting and fishing guide, who can decide himself when he is going to work.



Write a paragraph telling which three of these job characteristics are more important to you and why. Think of some jobs you might be able to get that have all three of these things.

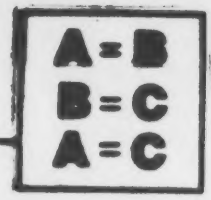


ANSWER KEY
WORKSHEET II

Accept any three reasons the students select, as well as logical reasons for selecting them.

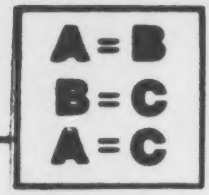
HOME and COMMUNITY

The student should ask his family to help him or her construct a "hayloft hygrometer" which is a homemade way of predicting bad weather. To build a hayloft hygrometer, one needs only a stick and a rope. The rope is attached to an overhead beam in a garage or on a porch with the stick tied in the middle to the bottom of the rope. When the humidity of the air increases, the rope absorbs moisture and its strands lengthen and unwind slightly, moving the stick in a circle. When the humidity drops, the rope winds up again, reversing the stick. Farmers used this device to tell the weather.



EVALUATION

Write a short paragraph about those reasons you selected in Worksheet II. Give your reasons for your selection.



EVALUATION

ANSWER KEY

Accept all logical answers.

COMPONENT II

Section Three

Section Three
The Grasshopper Plague

Key Words

- plague
- entomologist
- barometer
- insecticide
- agriculture
- humidity

Learning Objective

Given a narrative concerning the effect of weather on insect populations, the student will predict the outcomes of selected situations with 70% accuracy.

Materials

- copies of the activity sheet
- copies of the worksheet

Domains and Levels

Cognitive: Knowledge, Comprehension, Analysis

Affective: Receiving, Responding, Valuing

IMPLEMENTATION GUIDELINES

Time: *45 minutes*

STEP I - The teacher should introduce the activity by reviewing the difference between high and low pressure and their association with temperature and weather change.

STEP II - The students should read the activity to themselves or should take turns reading it aloud. Worksheets should be completed.

STEP III - The students should complete the evaluation sheet.

STEP IV - The Home and Community section is optional and should be implemented if time allows.

STUDENT ACTIVITY MATERIAL

The Grasshopper Plague

For Johnny Bearclaw this year had been a bad one. All of his crops had been eaten by a plague of grasshoppers which had swarmed over two entire states. Eight grasshoppers per square yard can eat as much as one adult steer. On Johnny's farm there had been over two hundred grasshoppers per square yard. They had not only stripped the fields of crops, but had eaten the leaves off the trees and chewed on the handles of shovels, pitch forks, and other farm tools.

Johnny was going to be ready this year, though. His friend, María López, was an entomologist, or scientist who studies insects. She had been studying the grasshopper problem and had learned a lot. The most important thing she had learned was that weather had much to do with the number of grasshoppers in any one year. Usually most grasshoppers are killed by frost in the fall before they can lay their eggs. The eggs that do get laid normally hatch at a time when spring rains and late cold snaps would kill many of the baby grasshoppers.

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As fall approached,Johnny, María and the other farmers and ranchers kept a sharp eye on the weather. October started off being warm and pleasant, but they knew that a wind shift could bring a front which would turn a summer-like day into the beginning of winter. When air currents or winds from the cold air mass hit those from the warm air mass, the cold air would force the warm air up because warm air is less dense than cold air. The mixture of warm and cold air causes water droplets to form causing rainy, stormy weather. The wind movements and moisture also cause the air pressure to drop. This drop in pressure is measured with a barometer. To use a barometer to predict the weather, other things like temperature, humidity and wind direction must be known. Nevertheless, a change in the barometer usually means a change in the weather.

Since it had been a warm fall and Johnny and María wanted colder weather, they watched the barometer every day to see if it had changed. Nothing happened. The fall stayed warm, and no frost occurred until almost Christmas.

"Well, we still have the spring," said Johnny.

But the spring was no better. They could use either lots of rain or cold weather. But their wishes were not granted this time either. Still, it wasn't as bad as it could be. There were ways to control grasshoppers by spraying with poison. If a plague did happen, as seemed likely, action would have to be taken quickly, before the grasshoppers reached the egg-laying stage.

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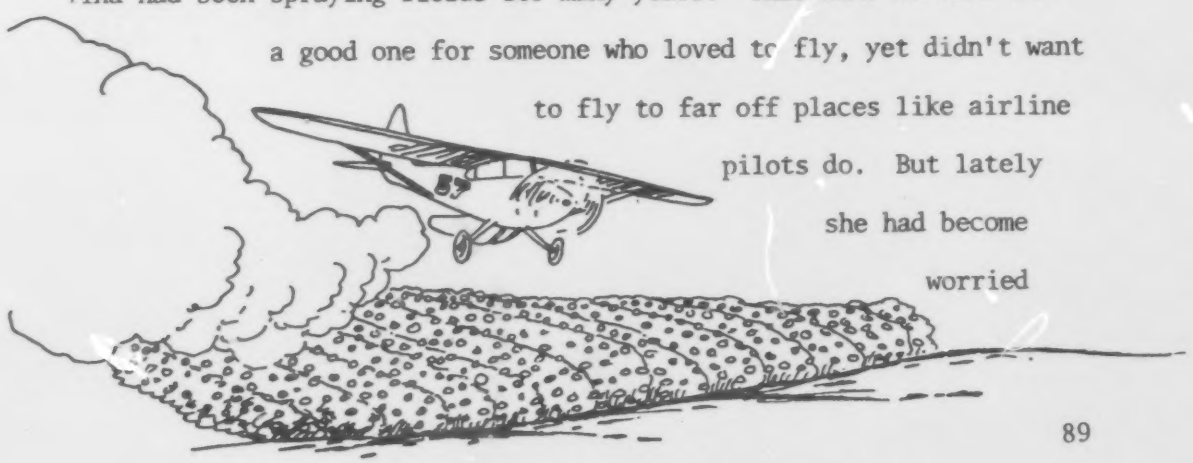
By the beginning of June, it did indeed seem like there would be a plague. Johnny and his friends called in Martin Weeks, who was the pest control officer. He advised them to have their fields sprayed with a certain kind of insecticide. María disagreed. She thought spraying with poison was bad because it poisoned humans, fish, and animals as well as insects. She knew of a new kind of pest control that a friend of hers, an entomologist, was working on. It was a special smell that smelled like female grasshoppers. It was not poisonous to humans or other animals, nor could humans smell it. But to male grasshoppers it meant that everything smelled like female grasshoppers. Since male grasshoppers find female grasshoppers by smell, the spray meant that the males couldn't find the females and, therefore, the females would produce no eggs.

Martin admitted that it was a good idea, but he still liked his old way. They finally decided to call in Tina Black, the agricultural pilot who would do the spraying, and ask her what she thought.

Tina had been spraying fields for many years. This line of work was a good one for someone who loved to fly, yet didn't want to fly to far off places like airline pilots do. But lately she had become worried



about her job because so many people were upset about the poison she sprayed. Some people said it made them sick, and other people said it killed their cows, chickens, and the fish in their ponds. When Tina heard María's idea, she was very happy. She would still get to spray pest control from her plane, but it wouldn't be poison.

With Tina on María's side, Martin gave in. María got some of the substance from her friend, and Tina got ready to spray it. She was very careful to choose a day that was cool and calm. Even though it wasn't poison, she didn't want any of it to go where it didn't belong. She also didn't want to have trouble with bad weather while she was flying.

To Martin's surprise the substance worked. The next year there were hardly any grasshoppers at all, even though the weather was again perfect. Johnny and his neighbors enjoyed large crops and fat cattle. María and her friend were happy because other counties and states now wanted to use this new substance. The grasshopper problem is not over, but at last it can be controlled without harming people or animals.

WORKSHEET

Predict the outcome of the following situations:

Situation I

Mosquitos spread some of the worse diseases of man and animals. They can be controlled by destroying the places in which they grow. Mosquitos lay their eggs in marshes, swamps, and pools of quiet water. Cold weather also affects the breeding of mosquitos. The county health officer is concerned this spring about the number of mosquitos in the city park. Make a prediction of the measures he may take to control them.

Situation II

It is a warm October day in Colorado. Around 11:30 A.M. there is a shift in the wind direction from SW to NW. The barometer is falling showing a drop in pressure. Humidity is increasing, and temperature is falling. Predict what may happen.

_____

_____

_____

_____

WORKSHEET ANSWER KEY

Situation I

He would suggest that the breeding place be located and drained; also the use of insecticides would be suggested. It would not be feasible to wait for cold weather, since people could be bitten and become ill in the meantime. Accept all logical answers.

Situation II

Cold air is moving in, and the warm air will be forced up, which may cause rain. Accept all logical answers.

HOME and COMMUNITY

There were lots of grasshoppers in Texas last year, too. The student should have his parents help him find weather reports from last fall and spring. After examining these reports, the student should make a predicion about the probable population of grasshoppers, given the weather conditions of the past year.

EVALUATION

1. Why is knowledge of weather important for predicting how many grasshoppers there will be for any one year? _____

_____

2. What is an entomologist? _____

3. Why might a warm fall mean more grasshoppers for the next summer? _____

_____

_____

4. Why does lots of rain in the spring help keep down the number of grasshoppers? _____

5. If you were a farmer who was worried about grasshoppers, what kind of fall weather would you be hoping for? _____

6. If you were this same farmer who was having a pleasant warm fall and if you noticed a change in the barometer, would you be happy or sad? _____ Why? _____

_____

7. If you were a pilot who was about to spray a field on a warm clear day and you noticed a change in the barometer, would you take your plane up? _____ Why? _____

_____

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EVALUATION

8. What are some of the good things resulting from spraying fields with poison? _____

9. What are some of the possible bad things resulting from spraying poison?

_____

10. If you had the choice between using a poison to kill insects or a biological control like the substance María's friend was working on, which would you choose? _____ Why? _____

_____

EVALUATION

EVALUATION KEY

1. Why is knowledge of weather important for predicting how many grasshoppers there will be for any one year? Because the right kind of weather in spring or fall will kill most grasshoppers.

2. What is an entomologist? a person who studies insects

3. Why might a warm fall mean more grasshoppers for the next summer? Because early frosts usually kill most of the grasshoppers before they can lay their eggs.

4. Why does lots of rain in the spring help keep down the number of grasshoppers? Because rain kills baby grasshoppers just hatched.

5. If you were a farmer who was worried about grasshoppers, what kind of fall weather would you be hoping for? Frosty, cold weather

6. If you were this same farmer who was having a pleasant warm fall and if you noticed a change in the barometer, would you be happy or sad? happy Why? Because a cold snap could bring frost which would kill grasshoppers.

7. If you were a pilot who was about to spray a field on a warm, clear day and you noticed a change in the barometer, would you take your plane up? No Why? A change in the weather could mean a storm.

EVALUATION

8. What are some of the good things resulting from spraying fields with poison? get rid of grasshoppers

9. What are some of the possible bad things resulting from spraying poison? Make people sick, kill animals, fish and other insects.

10. If you had the choice between using a poison to kill insects or a biological control like the substance María's friend was working on, which would you choose? _____ Why? _____

Accept all logical answers.

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Component 3

Section One

Section Two

Section Three

SATELLITE RESEARCH AND SPACE TRAVEL

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OVERVIEW

All of the activities presented in this component allow the student to learn about various professions in the Transportation Cluster. Each activity requires the student to design and manipulate materials to represent scientific principles, laws, or theories. Through the infusion of information about transportation careers and necessary scientific skills, the student will be better equipped to select careers in this area. The students will be led to realize the importance of science in these career choices and the need to acquire these skills.

GOALS

COMMUNICATING:	The student will be able to relate scientific methods to work activities in the Transportation Cluster.
FORMULATING MODELS:	The student will be able to design a simple experiment to test the ideas inherent in space-related transportation.
DEFINING OPERATIONALLY:	The student will internalize the importance of scientific concepts in selecting a career in transportation.

LEARNING SECTIONS

SECTION 1: What Are Some Transportation Careers?

SECTION 2: How To Do a Motion Experiment

SECTION 3: Some Skills You Need to Launch a Satellite

COMPONENT III

Section One

Section One
What Are Some Transportation Careers?

Learning Objective

Given a list of selected careers in the Transportation Cluster related to work activities found in science careers, the student will be able to associate the working activity with the corresponding career with 70% accuracy.

Key Words

- engineer
- technician
- principle
- law
- theory
- testing
- measuring
- model
- physics
- chemistry

Domains and Levels

Cognitive: Knowledge, Comprehension, Analysis

Affective: Receiving, Responding, Valuing

Materials

- sufficient copies of each transportation career narrative
- sufficient copies of the student worksheet
- sufficient copies of Transportation Career Evaluation

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should present the four short narratives to the students. The narratives include: Aerospace Engineer, Aeronautical Technician, Quality Control Inspector, Physicist. It is suggested that the narratives on the Aerospace Engineer, Aeronautical Technician and Quality Control Inspector be read as a whole either by teacher presentation, student(s) presentation or individual student reading.

STEP II - The teacher should give special emphasis to the first three narratives to provide a model of study which the students may use on the remaining narrative. Students should note the working conditions of each worker and compare them.

STEP III - The teacher should lead a discussion on the relationship of the first three narratives and the inter-relationship of the various careers and emphasize the necessity of scientific skills in each career.

STEP IV - The following list of questions is suggested.

(a) How does the job of the Aeronautical Technician relate to the job of the Aerospace Engineer? (Technicians offer assistance to engineers. Both careers need science and math skills; engineers are better educated in applied science.)

(b) What steps do engineers and technicians use to design new equipment? (Research, model or experiment, test, evaluate)

(c) What is the role of the Quality Control Inspector in the manufacture of new equipment? (Makes sure the equipment is built according to specifications.)

(d) Does the Quality Control Inspector need any science-related skill? (yes) What are some skills? (measuring, testing, evaluating)

STEP V - The students should read the remaining narrative about the Physicist.

STEP VI - The students should complete one "Transportation Career Investigation" using their choice of the four career narratives.

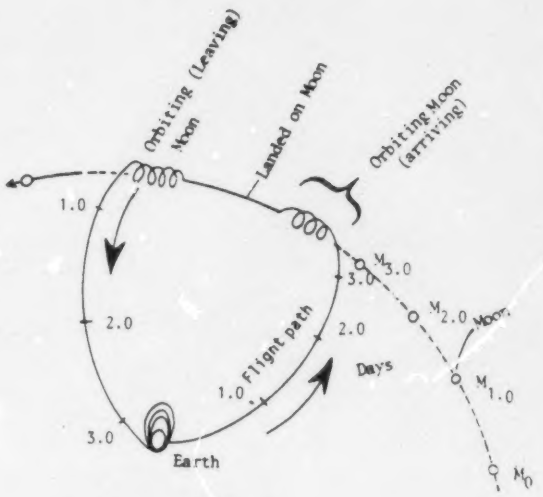
STEP VII - When the students have completed their investigations, the evaluation should be completed.

STEP VIII - The Home and Community section is an optional activity to be completed if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Space: The New Frontier

In the early sixties, President John F. Kennedy set a goal for the United States. The goal was to send a man to the moon within the next decade. The President's objectives caused many questions to be asked by scientists, engineers, and technicians in the space industry, questions like: Can man live in space? How can we get men into space safely? What kind of rocket do we use to get the men to the moon? How do we protect the men on the moon from harmful radiation? These questions and more had to be answered.



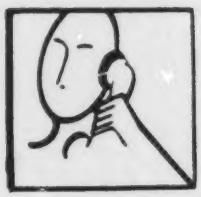
Flight Path to the Moon

Do you think you could build a rocket to get to the moon? What do you think you would need to know to build such a rocket? What skills would you need to build this rocket?

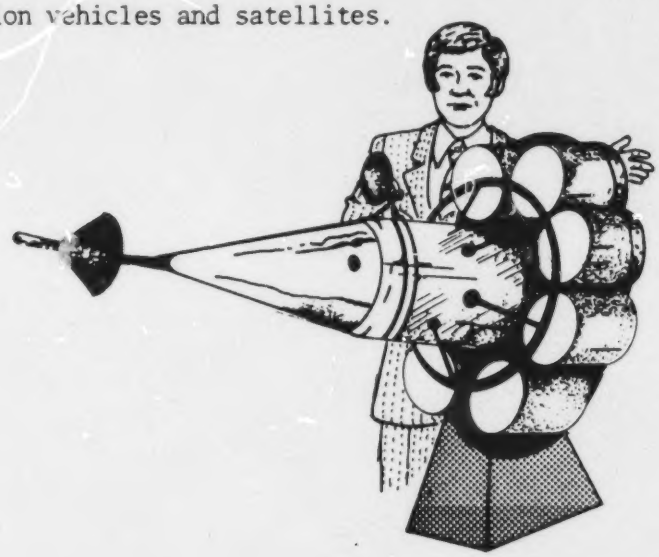
Let's meet some of the people who work building and designing space exploration vehicles.

Aerospace Engineering

Pepe Kamel has been working for Zoom Aircraft and Design, Inc. since he graduated from college. In high school and college, Pepe studied math and science, especially chemistry and physics. Pepe always wanted to fly

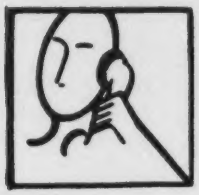


jets when he grew up. Because of this desire, he decided to study how planes are able to fly. In college, as he studied, he learned about the space program. Pepe wanted to be a part of the space program. He studied to learn more about rockets, missiles, space exploration vehicles and satellites. Pepe knew he had to specialize in some area, so he decided on the design of space exploration vehicles and satellites.



Today, Pepe works in a very pleasant, well-equipped laboratory and travels to test sites to test his designs. His job offers him security and many fringe benefits. Pepe also knows he must study more about his field, so he continues his education at night school taking more advanced science and math courses.

Recently, Dr. Juanita Garay, Pepe's boss, gave him a hard job. He had to design a nose cone for the new space shuttle. Pepe had to do a great deal of research on nose cone design before he could start building.



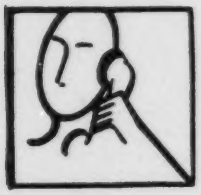
After Pepe had done his research, he began to build models of the nose cone to test. You see, Pepe knew that if the model nose cone didn't work, then it would waste money to build the real nose cone. The job was completed in one year by Pepe and his co-worker. Pepe knows that he may never fly in the space shuttle, but a part of him will be in space because of his work on the nose cone.

Pepe likes his job and knows that the new frontier is space. What do you think about Pepe's job?

_____

_____

_____



Aeronautical Technician

Alonso Martín also works for Zoom Aircraft and Design, Inc. Alonso helped Pepe to do the research and design of the space shuttle nose cone. Alonso had studied physics and chemistry in high school, but he was also interested in mechanical drawing and auto mechanics. Alonso always liked to work with his hands, but he also enjoyed science. Science helped him to understand how things worked and why some things didn't work. His other interests gave him the skills to apply the science he had learned in high school to an aeronautical technology training program he had completed.

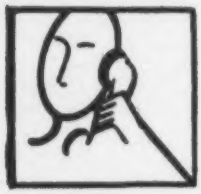
On the job, Alonso enjoys working with engineers like Pepe. They make such a good team, their fellow workers nicknamed them the "designing duo." He helps Pepe do research, build models, test, experiment and write instruction manuals. Alonso has to be very accurate and pay attention to details in his job. Sometimes he works in the pleasant laboratory, but at other times he gets his hands dirty building and testing new devices. Alonso thinks he has the best of both worlds. His interest in science and his desire to work with machines and equipment are both fulfilled.

Alonso's job offers him a good salary, fringe benefits, fulfillment and satisfaction. He knows that with his background and experience, he will always have a good job.

Quality Control Inspectors

María Martínez is the Quality Control Inspector for the same aircraft company Pepe and Alonso work for. After they complete all the design and experiments on the space shuttle nose cone, another part of the company will build the new nose cone. María's job is to inspect the nose cone after it has been manufactured. She has to be able to read tables and charts and measure the nose cone for size, test it for strength and construction, and understand many complex blueprints and specifications. She must make sure the nose cone is exactly what Pepe and Alonso designed, or it will not work on the space shuttle. María must decide if the nose cone is good, or if it should be rejected. She has an important job even though she only went to high school. She studied mathematics, chemistry, physics, mechanical drawing and shop.

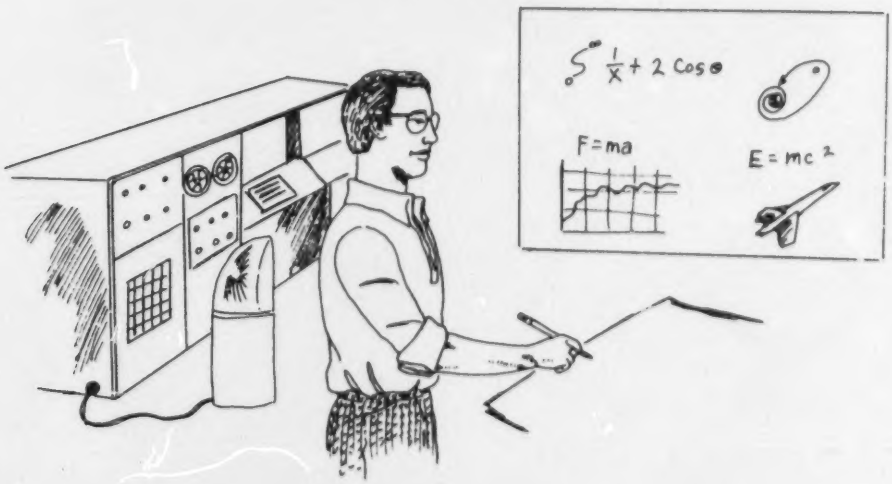
María was not always in such an important position. When she went to work for Zoom Aircraft and Design, Inc., she had on-the-job training and took other courses in shop mathematics and blueprint reading. She always found it easy to use tools and delicate instruments and to pay attention to detail. María then found it easy to go on to higher positions in her department after she gained more skills.

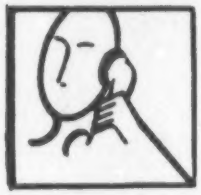


Physicist

Lu Tung is a theoretical physicist. He works for NASA on the space shuttle program. He works long hours under many different conditions. His job with NASA is to find the best and safest way to launch the space shuttle at Cape Canaveral. Lu has his Doctor's degree in physics and is very intelligent. He has always been very good in mathematics and science. He enjoys working with ideas and theories and analyzing information to reach a conclusion. In high school, Lu took all of the advanced math courses, chemistry and physics.

Lu's main concern at NASA is how to get the space shuttle (150 tons) into space safely and get it back safely. This is a big problem for Lu, and he needs to do a great deal of research to understand the problem. He has to use principles, theories, laws, models and a lot of math like





calculus to solve this complex problem. He may also have to use very complex computers to help him in his search for the answer.

Lu likes this kind of job. The job offers him travel, excitement and, best of all, new problems to solve. Are you good in the math and science courses that you are taking in school? Do you like to solve complex problems? If you answer yes, you may be just right for the job of a physicist. Just remember, Lu's job is only one kind of physicist's job. Do you know of any other jobs that physicists do?

Transportation Career Investigation

Exercise

Choose one of the four careers you read about. Answer the following questions.

Name of Career_____

1. What would you do on the job in this career?

_____

_____

_____

_____

_____

2. How would you use science in this career?

_____

_____

_____

_____

_____

3. What would you like about this job?

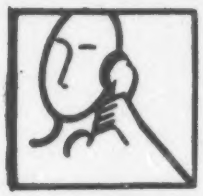
_____

_____

_____

_____

_____



4. What are the working conditions of this job?

HOME and COMMUNITY

The student should talk with the members of the extended family. Family members should be questioned about the use of science in their job environment. If a member of the family is in a transportation career and deals with science in that career, it is suggested that either:

(1) The student interview the person and report to the teacher or the class.

(2) The family member be invited to the classroom to discuss his or her job and the use of science skills in their work.

Outside sources from the classroom are always enriching. Contact your local engineering group or association and ask for a speaker to discuss the impact of science in transportation with the class. Students may be encouraged to solicit information from neighbors in regard to the use of science in transportation careers.

EVALUATION

Before each activity on List 2, write the letter corresponding to the career on List 1 that would have that skill. Some skills may require more than one answer and others may have only one. You will need to use the different careers more than once.

List 1

A. Aerospace Engineer

B. Aeronautical Technician

C. Quality Control Inspector

D. Physicist

List 2

___ 1. Does research; makes, tests and evaluates models.

__ 2. Travels to test sites.

__ 3. Must be very accurate and precise on the job.

____ 4. Must be able to apply scientific principles, laws and theories.

__ 5. Needs to work with tools and read blueprints.

__ 6. Must be very good with advanced math and advanced science, and work with principles, laws and theories.

__ 7. Helps the engineer do his job and is good with his/her hands.

__ 8. Designs new space exploration vehicles.

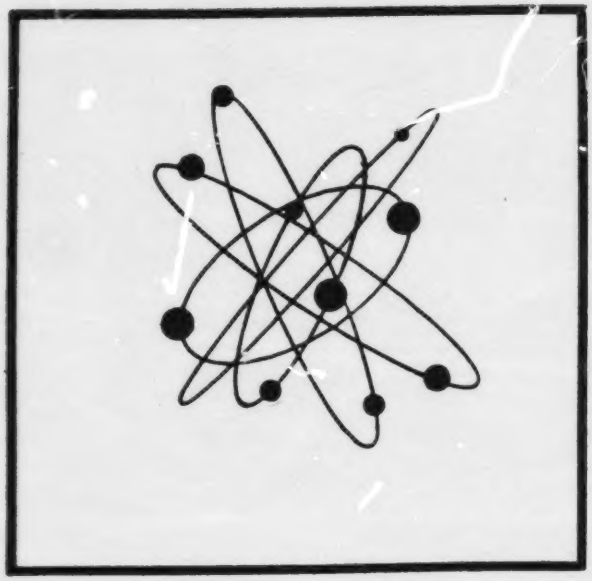
____ 9. Needs the knowledge of chemistry and physics to do the job.

__ 10. Receives on-the-job training for his/her job.

EVALUATION

Answers

1. A,B,D
2. A,D
3. B,C
4. A,B,C,D
5. C
6. D
7. B
8. A
9. A,B,C,D
10. C



COMPONENT III
Section Two

Section Two
How to Do a Motion Experiment

Key Words

- model
- mass
- meter
- centimeter
- aerospace engineer
- aeronautical technician
- quality control inspector

Learning Objective

Given the problem of constructing a model (paper airplane), the students will perform in their role situation to achieve a successful model within the specifications given. Completion of the model according to the teacher's criteria.

Materials

- name tags
- triple-beam balance
- meter stick
- paper clips
- paper (8" x 10")
- tape
- scissors

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis, Synthesis

Affective: Receiving, Responding, Valuing

IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The activity is designed to allow the student to role-play a given science-related career in Transportation. The students have to operationalize given specifications in the construction of a model paper airplane according to the careers assigned. NASA is an important source of information about future jobs in the transportation cluster on a national level.

STEP II - Students should be familiar with the use of a triple-beam balance and meter stick before attempting this activity.

STEP III - Students should be placed into groups of three and issued name tags for career identification and role function. The teacher should wear the "NASA Representative" identification tag.

STEP IV - The narrative "What goes up, must come down" may be read by the groups or by the teacher to the class with an explanation of the requirements. It may be helpful for the teacher to show a model that is within specification for the students to internalize these requirements.

STEP V - A "test site" should be designated in the classroom and marked as such. Masking tape may be placed on the floor at the "test site" to aid in flight inspection of the models being tested. See diagram below for test site construction.

IMPLEMENTATION GUIDELINES

STEP VI - The teacher should stress the role of each designated individual in the groups.

(a) Aerospace Engineer - Designs the model(s) within requirements and corrects any problem found in the model(s).

(b) Aeronautical Technician - Aids the engineer with construction of the model and tests the model to see if it meets all the requirements.

(c) Quality Control Inspector - Makes sure that the model(s) meet all the requirements through an ongoing and final inspection of the model before it is presented to the NASA Representative.

STEP VII - Students should be given a "free hand" with the design and encouraged to experiment. The only criterion is that the students stay within the specified requirements of the project.

STEP VIII - The Home and Community Activity is optional, to be assigned if there is time.

STUDENT ACTIVITY MATERIAL

A New Project

Zoom Aircraft and Design, Inc. has been given a new project from NASA. NASA wants them to design a space shuttle (paper airplane) for exploration. The shuttle must meet the special requirements given by physicists, or it cannot be launched by a rocket. Your team assignment is to build a model of the space shuttle according to NASA's requirements.

NASA'S Requirements

Flight - your model must fly in a straight path for at least four meters or more

Landing - your model must land gently (not crash)

Wing span - The wings cannot be less than 10 centimeters wide nor greater than 15 centimeters wide

Length - The length cannot be less than 15 centimeters wide nor greater than 30 centimeters

Mass - The model cannot have a mass greater than 5 grams.

Construction Materials - paper, tape, paper clips

Inspection Equipment - Triple-beam balance, meter stick

Teams - Each three-person team is composed of an Aerospace Engineer, an Aeronautical Technician and a Quality Control Inspector. Each person in the group should have a tag telling which career is represented. The Aerospace Engineer and Aeronautical Technician should work closely in building the model according to NASA's

requirements. The Quality Control Inspector has to make sure the model that has been designed and built is perfect and meets the requirements of NASA.

The team must be able to explain to the NASA Representative (teacher) why or why not the model(s) they developed worked. The team may build as many as two models to achieve the requirements set by NASA. Only one model may be presented to the NASA Representative. Remember, time is money on such a project.

Steps to build the Space Shuttle model -

(1) Discuss with the team or as a class the NASA Requirements

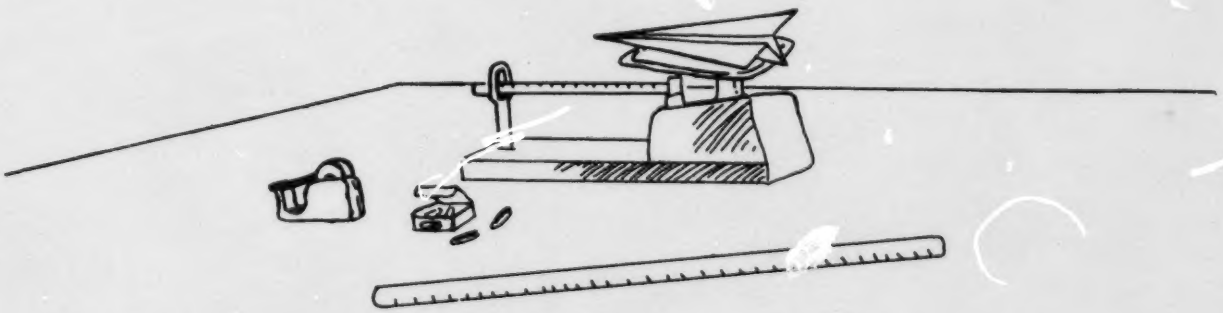
(2) Research - (think about) the different ways you could build your model(s)

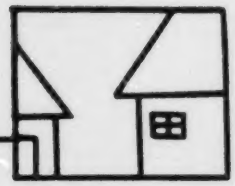
(3) Design - Build your model(s)

(4) Test your model(s) at the test site in the class room.

(5) Pass inspection by the Quality Control Inspector

(6) Present your best model to the NASA Representative (teacher)





HOME and COMMUNITY

Students may take a field trip to an aeronautical museum to see how science has improved the transportation industry over the years. Students may then exercise their imaginations and predict the future. They may make an oral or written report on their predictions. The theme of this report might be "Transportation Jobs in the Year 2080."

EVALUATION

"What goes up,must come down"

(1) What was the name of your job in building the model space shuttle?

_____

(2) What did you have to do in this job? _____

_____

_____

(3) What science skills did you need to do your job? _____

_____

_____

(4) What were the names of the other jobs on your team? _____

_____ and _____

(5) What science skills did the two people in question four (4) need to do their jobs? Write the career in the blank and the skills in the next biank space.

career_____skills_____

career_____skills_____

(6) How can science help you do a better job in the jobs that are in transportation?

_____

_____

_____

EVALUATION

(7) Do you think the United States will need more or fewer workers like those at NASA in the future?

_____

_____

_____

EVALUATION

ANSWERS

Answers will vary, but all options are given below.

(1) Either Aerospace Engineer, Aeronautical Technician or Quality Control Inspector

(2) Aerospace Engineer - design models within specifications and correct problems

Aeronautical Technician - assist engineer to design models and correct problems

Quality Control Inspector - Check to make sure the model met all requirements

(3) Aerospace Engineer - knowledge of aircraft design, variables that affect design, measurement and testing skills, laws and principles of flight

Aeronautical Technician - knowledge of construction principles and aircraft design measurement, and testing skills.

Quality Control Inspector - understand specifications, measure and test model against specifications, use of measurement tools.

(4) Either . Aerospace Engineer, Aeronautical Technician

. Aerospace Engineer, Quality Control Inspector

. Aeronautical Technician, Quality Control Inspector

(5) See answer 3 for the alternatives

(6) Science gives you the knowledge and skills needed to build and test designs in order to produce a better product.

(7) Accept all logical answers.

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COMPONENT III

Section Three

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Section Three

Some Skills You Need to Launch a Satellite

Key Words

- aerospace engineer
- aeronautical technician
- quality control inspector
- physicist
- laws
- principles
- theories
- skills

Learning Objective

Given four practical situations in the field of transportation, the student will relate the importance of scientific knowledge and skills to these careers and be able to describe the problems that may occur if these skills are incorrectly applied or unknown. Evaluation according to whatever criteria the teacher establishes.

Materials

- sufficient copies of the activity sheet for each student

Domains and Levels

Cognitive: Knowledge, Comprehension, Application, Analysis, Synthesis

Affective: Receiving, Responding, Valuing, Organizing

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IMPLEMENTATION GUIDELINES

Time: *45 Minutes*

STEP I - The teacher should introduce the activity by reviewing the science skills that may be necessary to the field of Transportation. Skills that may be mentioned are as follows:

research, construction of models, testing or experimentation; knowledge of laws, principles and theories; measurement techniques; use of tools and instruments.

STEP II - Various teaching strategies can be used:

(a) Class discussion - The teacher or a student may read each situation orally. Then students may discuss the situation and determine plausible solutions to the questions. This oral discussion will permit many students to contribute to the solution.

(b) Individual - The students will read the material and complete the activity by themselves. It is recommended that a discussion of answers in class follow this method so as to enrich the learning activity through increased input by the students.

STEP III - Evaluation

STEP IV - The Home and Community activity is optional and may be assigned if there is sufficient time.

STUDENT ACTIVITY MATERIAL

Space Exploring

(1) Remember Pepe Kamel, the Aerospace Engineer? He is always being given tough assignments by his boss for the space industry. Pepe has to apply the science he learned in school to his job every day. He has to research his assignments, build models and test them to understand if they will work properly. (a) Do you think Pepe could build a satellite if he didn't understand the laws, principles and theories associated with the science of satellites? (b) Can you give an example of a scientific principle, law or theory that an Aerospace Engineer may use on his/her job?

_____

_____

_____

_____

(2) As an Aeronautical Technician, Alonso often does scientific measurements on new designs that have been sent to him for testing. One of the measurements Alonso applies to materials used to build space vehicles is a temperature test. He measures the temperature at which the material will melt or burn up. It gets very hot when space vehicles are brought back to Earth. (a) What might happen if Alonso made a mistake on the temperature testing of the nose cone for the space shuttle? (b) What may happen to the men in the space shuttle? (c) Can you think of some way that Alonso could avoid this kind of mistake?

(3) The Quality Control Inspector's job is very demanding; María knows that she must understand how to test new products for the space industry. If she does not test a product correctly and the product goes into space, it may fail. María's present assignment is to inspect a new missile to be used in launching a very expensive satellite for NASA. The plans she uses to check the missile are very complicated. (a) What are some science-related skills that María will use to test the missile? (b) What may she do many times to make sure she is correct about her tests on the missile?

(4) Lu Tung is a physicist for NASA. He works with laws and theories of flight in space by missiles. Lu is working on the flight path of a missile to the moon. He needs to know the speed of the missile, the distance to the moon, and where the moon will be located in its orbit around the Earth. (a) What will happen if Lu does not calculate the speed of the missile correctly? (b) What may be the results

of the moon not being in the right place when the missile gets there to land? (c) What do you think will happen if the moon is closer to the Earth than Lu predicted? (d) What can Lu do to make sure that problems like these do not happen?

Answers

(1)a. Pepe would not be able to build a missile without scientific laws, principles or theories.

b. Many answers are possible. Some answers may be: law of gravity, measurement of mass, density or speed, construction techniques, Newton's laws of motion, durability of materials.

(2)a. The space shuttle may burn up on re-entry, the shuttle will overheat due to the lack of heat dissipation or nothing may happen.

b. The man in the shuttle may be killed on re-entry if the shuttle overheats or burns up.

c. Alonso could re-test the temperature measurement several times. Alonso could also have another person do the experiment and compare the results. He could also check periodically on the proper functioning of his testing equipment.

(3)a. The science-related skills María will use on the job may be a knowledge of chemistry and physics, measurement of mass, length, volume, density, electric voltage, and amperage material construction measurements.

b. María may make the same measurement several times to insure accuracy.

(4) a. One of two possibilities exist.

(1) The missile will not get to the moon.

(2) The missile will overshoot the moon or crash.

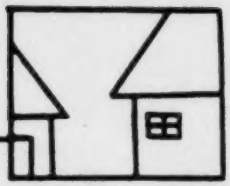
b. The missile will miss the moon if the orbit of the moon is not calculated correctly.

c. The missile may crash on the moon due to excessive speed.

d. Lu can prevent such problems by:

(1) Duplicating the situation with a model

(2) Have other people solve the problem and compare the results



HOME and COMMUNITY

HOME: The student may discuss with family members if and how the knowledge and skills used in the space program have impacted transportation, either from the point of view of a user of transportation or as it relates to their job in transportation.

COMMUNITY: The student may wish to write to the National Aeronautics and Space Administration Board in Washington, D.C. and ask whether the space program has had a strong effect in the careers of transportation or any other questions that may have surfaced in regard to transportation and the sciences.

EVALUATION

Answer the following problems:

(1) Pepe, the engineer, and Alonso, his technical assistant, are given the task to design a wing for a supersonic jet. Both men work closely on the research, the model of the wing and the testing of the model. The wing they build has some problems, but Pepe and Alonso did not see them.

a. What could happen to the supersonic jet if the faulty wing is used?

_____

_____

b. How could the problem have been found and corrected?

_____

_____

c. How could this error affect Pepe and Alonso's jobs with the company?

_____

_____

EVALUATION

(2) The physicist for NASA, Lu Tung, knows a great deal of the science of launching rockets. One law he uses says that "the bigger the rocket, the more fuel will be needed to launch it into space." Lu reversed this law one day by accident and thought it said "the smaller the rocket, the more fuel you will need to launch it into space"

a. What kinds of problems could Lu cause if he used the incorrect law?

_____

_____

_____

_____

b. What do you think this type of mistake could do to Lu's future as a physicist?

_____

_____

_____

_____

c. What are some precautions Lu could take to prevent such an error?

_____

_____

_____

_____

EVALUATION

Answers (Suggested)

(1)a. The supersonic jet could crash

b. Further research models and testing may be done, or quality control inspectors may find the problem.

c. They would be fired.

(2)a. Rocket may have too much fuel and cannot be launched; rocket may have too little fuel and cannot be launched.

b. Lu may not be trusted as a valuable scientist; he may lose his job or he may be reprimanded.

c. Lu could use predictive models, computers, additional staff to review his findings on fuel consumption and check his work